SUPPLEMENT.

The Mining Journal,

RAILWAY AND COMMERCIAL GAZETTE:

FORMING A COMPLETE RECORD OF THE PROCEEDINGS OF ALL PUBLIC COMPANIES.

No. 1629.—Vol. XXXVI. LONDON, SATURDAY, NOVEMBER 10, 1866. {STAMPED .. SIXPENCE. UNSTAMPED. FIVEPENCE.

MECHANICAL VENTILATION OF COLLIERIES.

Fig. 1.

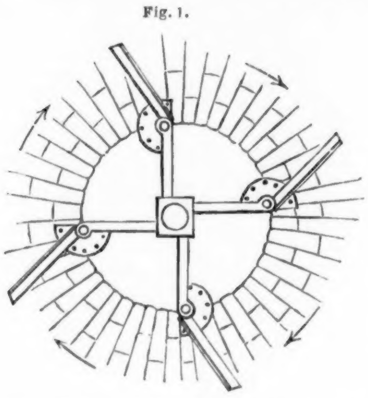


Fig. 2.

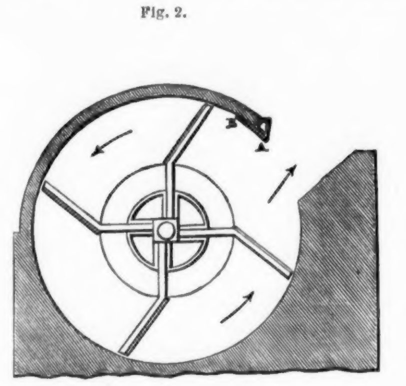


Fig. 3.

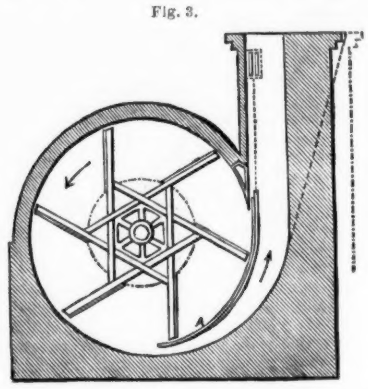
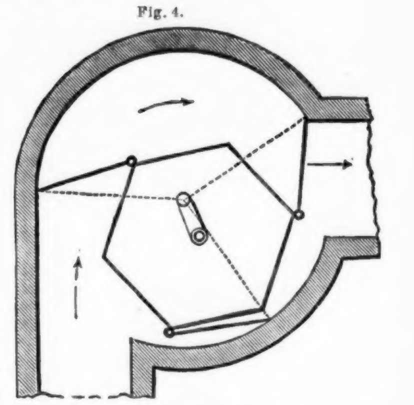


Fig. 4.



Some seven years since a very interesting paper was read before the North of England Institute of Mining Engineers by Mr. Laurent, upon an improved ventilating machine, invented by Mr. Lemielle. In alluding to this machine, so long since as March 2, 1861, it was stated in the *Mining Journal* that the ventilator had been in operation for some seven or eight years previously at the mines of Sars-Lonchamps and Bouvy, at Saint Vaast, and that it had also been for some time in use at the mines of Azincourt and St. Auguste, the officials, after four years' trial, declaring that with a very moderate speed the results obtained during that time had been very satisfactory; the consumption of fuel not being large, whilst its maintenance was insignificant, although it had been continually in operation. It is now proposed to take energetic measures to introduce the invention into this country, which, judging from the success which has been achieved on the Continent, will not be a very difficult task.

Upon the question of centrifugal machine ventilation generally, and the merits of the eccentric fan ventilator in particular, Mr. Lemielle has compiled an interesting pamphlet, in which, with much fairness, he shows what had previously been done in the same direction, of course, pointing out the advantages of his improvements. The first ventilator of this description to which Mr. Lemielle directs attention is that of Mr. Letoret, shown in Fig. 1, above. This ventilator, patented No. 3, 1841, has been extensively used in Belgium, and in other countries, at the period when the works were of limited extent. Fig. 2 is the same ventilator as the preceding, constructed to work either enclosed in a circular casing or not. In 1848 it was encased in wood, and in 1850 in masonry, with a single outlet, which could be opened and closed by means of a small sliding door, A, B. Toward the end of 1850, a chimney was added by Mr. C. Plumat, then engineer of the Boussu, Ste. Croix and Ste. Claire Collieries, and the example was afterwards followed at L'Agrappe-Escouffiaux, and elsewhere. The next ventilator of the same kind is that of Mr. Dollfus, and illustrated in the *Genie Industriel*, in 1854. It is simply a revolving fan, placed eccentrically within a casing, so as to facilitate the free escape of the air. The diagram of Mr. Decoster's ventilator follows, and next the ventilator constructed in 1859, at the Charbonnages des Produits and Company of Belgian Collieries. This ventilator has since been copied by a great number of collieries in Belgium. It is practically a Dollfus fan, the arms of which are bent slightly backward, instead of being fixed radially. Next in chronological order comes that of Mr. Guibal, patented in 1861, and shown in Fig. 3, the slide A is to regulate the exit of the air, and can only be regarded as a complication calculated to compensate for errors in proportions in other parts of the apparatus, for it should be mentioned, and well kept in view, that the extremes from the greatest success to the most complete failure in fans of all kinds, and especially in eccentric fans, will result from very slight errors of proportions. Fig. 4 is the improved fan of Mr. Lemeille, of which the model was exhibited at the meeting of the North of England Institute of Mining Engineers, on Saturday.

In again directing attention to the improved ventilator, Mr. Ellis Lever, of Manchester, who has undertaken the agency for this country, writes that during a recent visit to Belgium and France, with Mr. Jacob Higson, M.E., he has ascertained that 150 of these machines are now at work on the Continent, and he has it on the authority of Monsieur Canelle, Mining Inspector of the Imperial Government of France, that throughout France and Belgium Lemielle's invention is rapidly superseding the furnace and all other ventilating agents. Some of the pits where Lemielle's ventilator is employed are 350 fms. deep, and extract from that depth 102,000 cubic feet of air per minute, working at only 18 revolutions per minute.

The apparatus erected at Ashton Vale Works, near Bristol, worked most satisfactorily for some time, although it was only half the power of those usually employed. The Lemielle ventilator is a rotatory pump of the most ingenious yet simple construction; the wings, or doors, which form the pistons, are so arranged that whilst in the act of aspiration they fill a very large space, but as soon as they have done their duty they collapse, so to speak, and return ready for another stroke with the smallest possible waste of air. The machine may be thus described:—The cylinder is a large circular chamber of brickwork, or masonry, and the rotation of a piston within this chamber creating a partial vacuum behind it, draws a current of air through the upcast, and discharges it into the atmosphere. The piston consists of three doors, or wings, fixed upon a vertical hexagonal support the diameter, from a given angle to that directly opposite, of which is about two-thirds the diameter of the cylinder. The wings are fixed on the alternate angles, and their outer ends are connected by connecting rods with an axis in the centre of the cylinder. Now, as the axis upon which the hexagon rotates is so placed that the angles of such pass as closely as practicable to one side of the cylinder, it is evident that the doors may be made to open in the pumping half of the rotation, and to close in the return half; and it is in this that the Lemielle ventilator has proved so successful. The outer ends of the connecting-rods are always close to the side of the cylinder, but as the angles of the hexagon are sometimes nearly in contact with the side, and sometimes one-third of the diameter (of the cylinder) away from the sides of it, it will be apparent that as the angles approach the sides of the cylinder the doors are drawn in towards the side of the hexagon, and that as the angles recede from the side of the cylinder the doors open out from the side of the hexagon. The double centre is obtained by the use of a fixed crank; the axle is in the centre of the hexagon, and the arm in the centre of the cylinder. The hexagon is fixed to the upper end of the axle, which is a rotating pivot, the lower part of the said hexagon being furnished with a bearing, or bush, to work round the lower end of the axle, which is fixed and immovable. The connecting-rods work round the arm of the crank with the effect we have mentioned.

A carefully-made series of experiments by Mr. Declercq, the chief engineer of mines, before a number of French and Belgian Government engineers, at the colliery of Nord du Bois de Boussu, shows excellent results. According to contract, Mr. Lemielle's ventilator was to extract from the mine, by making 15 revolutions per minute, 40 cubic yards of air in a second, under the depression of 3″142. The engine is to work with a real steam-pressure of four atmospheres. The air-passage gallery was to have a section of 54 square feet. The central body of this ventilator was a hexagon, and had three wings. The chief dimensions were—height of body, 16′ 4½″; width of wings, 8′ 2½″; radius of eccentricity, 2′ 8¼″; diameter of the casing in which the apparatus moves, 23′ 4¼.″ Mr. Lemeille made several improvements in the construction of his apparatus. The most important of them is that its weight no longer bears on the lower pivot. A collar, like those of cranes, fixed at the upper part of the ventilator, bears the greater part of the weight, and by means of a screw the apparatus may be easily raised or lowered. The details of each trial were given in the report, which concludes—"We declare that Mr. Lemielle has amply fulfilled the engagements he has undertaken with the colliery of Boussu, because his ventilator is firmly established, and as, by working half a turn less per minute, he extracts from the mine every second 3·392 cubic yards more than the amount fixed upon in the contract, and at depression of 3″739, instead of 3″142"—than which nothing could be more satisfactory.

ON MINING ACCIDENTS, AND THEIR PREVENTION.

An ordinary monthly meeting of members of the London Association of Foremen Engineers Society took place on Saturday, Nov. 3, at its rooms in Doctors' Commons, City. More than usual interest had been excited on this occasion by the announcements previously made that Mr. J. Newton, President of the Association, and Mr. George F. Ansell, of Her Majesty's Mint, would read papers on "Mining Accidents, and the Means of Preventing them;" and, accordingly, when at eight P.M. Mr. Newton took the chair, the assembly room was densely thronged. After the routine business had been disposed of, and several new members—among them Mr. Smith, manager for Messrs. Moreland's, Old-street—were duly elected,

The Chairman proceeded to say that it was not his intention on the present occasion to invite attention for any length of time. Such remarks as he had to offer were like the introductory pages of a good volume, only intended to pave the way towards something of far more interest which was to follow. His talented friend, Mr. Ansell, who had so kindly consented to come among them that night, was much more able to deal with the subject of mines, and mining economy, than himself, and it would be simply presumptuous for him to stand long between that gentleman and the numerous auditory which he was glad to see had assembled to hear Mr. Ansell's lucid explanations, and to witness the very interesting experiments by which those explanations would be illustrated. Still, with their permission, he would advance a few observations which, he might say with truth, owed their origin mainly to the fact that it had been his privilege to have had constant communication with Mr. Ansell during several years, and that he (the Chairman) had thus become imbued with an interest in this great question which he had not previously felt. In reality, indeed, he pleaded guilty to having been for a very long period a sharer in what he now considered that almost criminal apathy which prevailed in respect to the life, the labours, and, alas! the frequent and violent deaths of those whose lot it was to toil underground in coal and metal mines. Like too many members of the British community at present, it was his own habit formerly to pass over the recital in the public papers of the various and continually recurring accidents in the coal pits of Great Britain, as if they were matters of course—inseparable from the occupation in which the unfortunate sufferers were engaged, and which no human precaution could prevent. Such ideas he had long since discarded as unworthy and unjust, and it was his earnest desire that the proceedings of that evening might tend in no inconsiderable degree to remove them from the minds of others. It was of the utmost consequence that in regard to mining operations a broad line of demarcation should be drawn between that list of casualties which were inevitable, and that which included only preventible accidents. In respect of sanitary science, that distinction was becoming day by day more completely understood and acted upon. Thanks to the exertions of philanthropists, and of "wise physicians, skilled our woes to heal," we were lessening the death lists of our towns, and making our villages more healthy. It had been clearly ascertained for example, and demonstrated beyond the possibility of contradiction, that the influences of filth were stronger than those of the preacher, or the policeman, and that the foundation of physical comfort and moral excellence among a working and poor population consisted in the furnishing each dwelling with a pipe of wholesome water from bottom to top. A current of fresh water would sweep away fever and cholera from a crowded locality, and stave off future invasions of the same dread foes. In the mine a current of air would remove, or dilute, poisonous and inflammable gases, and prevent the occurrence of those fearful catastrophes which they so often had to deplore. The same, or similar laws operated in the one case as in the other, and it behoved the Legislature of a civilised country, in which human life was supposed to be of the highest possible value, to *enforce*, if need were, the application of those laws to meet both cases, and thus to place a shield of protection over those who were not able to protect themselves.

Returning, however, to the subject immediately under consideration—"preventible accidents in mines," it must be admitted that the great panacea for effecting the avoidance of a large proportion of such accidents was Ventilation. Death from the explosion of fire-damp, or from the subsequent inhalation of choke-damp, would not occur at all if the ventilation of mines were made perfect. If the composition of the air circulating throughout the various passages of a coal pit, which passages were usually cut in such a way as to give the pit the appearance, on a small scale, of a town in which the streets were rectangularly arranged—if the air circulating through those passages could at all times be made to approach in purity to that which circulated on the bank, or surface, such a calamity as that which had occurred on Thursday last would be simply an impossibility. No doubt the problem—"How best to ventilate mines effectually?" was a difficult one to solve, and it certainly had not as yet approached a solution. It was one which might well engage the attention of members of such societies as their own, and it would be better if Government were to offer annually a prize, or prizes, for the best efforts made in that direction. Meantime, it was abundantly manifest that the poor miner had to perform exceptional duties under exceptional circumstances, and that the exceptions, and the rule too, were all to his disadvantage. His occupation at present was not only "hazardous," but fraught with danger, and his life at best was worth little more than a few years' purchase.

In view of these facts, and of many others of the same character which might be adduced did time permit, it behoved the mechanical and the scientific men of England to endeavour to remove the stigma which now rested upon them—that of leaving a host of preventible mining accidents unprevented, and of entailing unheard-of miseries upon thousands of orphans and hundreds of widows, who indirectly were victims to them. He (the Chairman) must confess that he felt humiliated and abashed, as well as shocked and pained, when he read such dismal accounts as those which appeared in the papers of yesterday of the colliery accident at the Pelton Fall Pit. These consequences followed from the knowledge he had gained, that at least three-fourths of the so-called "accidents" were the result of sheer neglect, and, therefore, fell into the category "preventible." He hoped he was not vindictive, but he believed that verdicts of manslaughter against, and the subsequent punishment of, persons shown to be responsible for such disasters would produce a very salutary effect on others who were equally indifferent to human life, and, therefore, equally open to censure.

This preface to his friend's volume of scientific truths was, he was afraid, rather too long for the patience of his fellow-members, and he would, therefore, hasten to conclude it. It would be found that Mr. Ansell had devoted a very considerable amount of attention to his subject, and that he would impart so much of valuable information as to induce all to say that they were very glad they came to hear him. That gentleman was, at least, actuated by the desire to save life in our mines, and his Indicator, although, as he no doubt would tell them, not intended as a substitute for ventilation in the world underground, was an admirable adjunct to mining appliances, as mining is now carried on. It was his intention to have entered slightly into the question of the probable duration of the coal supply of Great Britain, but that was, under existing circumstances, perhaps better left alone. He

might simply furnish a few statistics as to the quantity of coal and iron raised and consumed, or exported annually, in order to show the magnitude of those sections of national industry, and then leave Mr. Ansell face to face with his audience. It appeared, then, from the best sources of information, that in the past year (1865) our consumption of coal equalled at least 100,000,000 tons. An estimate had been framed which went to show that of this enormous aggregate about 30,000,000 tons were used for domestic purposes—or 1 ton for each inhabitant, young and old, of the United Kingdom. In the manufacture of the 5,000,000 tons of iron, which took place during the same period, 24,500,000 tons of coal were consumed; whilst our exports of coal in the same year equalled 10,000,000 tons. This left upwards of 30,000,000 tons for the various other manufactures going on constantly in this great workshop of the world—in the construction of railways, the conducting of steam navigation, &c. It was probable that the average value of the coal so raised was 5s. per ton, giving a gross value of 25,000,000*l*. Who could describe the ramifications of such a sum spent in wages and materials? It circulated throughout the land like our life's blood through our veins, and produced a vivifying effect upon the whole industrial community. It was to the labours of half a million or so of miners that we were indebted for this gigantic and never-failing—at least in our day never-failing—harvest of mineral wealth; and who would assert that the harvestmen were unworthy of our consideration, or that their lives were to be heedlessly squandered? Every inhabitant of these islands was directly indebted to the subterranean toilers in our pits and mines, as much as to the workers in our fields, who ply their avocations under the cheering influence of the sun's rays, and provide us, humanly speaking, with our daily bread! In was on behalf of those unseen and undemonstrative labourers of Great Britain, to whom so much was due, that they had met that night, and he trusted that their meeting would not be in vain.

There were among the members of that association able, intelligent, and practical men, and he (the Chairmen) trusted they would join freely in the discussion, after Mr. Ansell's expositions had been made, and that such members of the Press as might be present would take care to report at least an abstract of their proceedings, for the advantage of the public, and the vital gain of colliers and miners. He begged now to introduce the lecturer of the evening, and to ask for him that kind attention which had been extended to his own rather crude and undigested remarks. (Cheers.)

Mr. ANSELL, who was much applauded, now advanced to the lecture table, which presented the appearance of a bench in a chemist's laboratory, and proceeded to say that, having been invited to lecture on the subject of his Fire-Damp Indicator, he had sought to make that subject interesting by introducing as many practical details as might fairly be said to belong to it. He would remind the gentlemen present that the circumstances in coal pits were exceptional, for there was no room to spare, every yard having been gained by labour of an expensive kind. Want of space constituted the great source of danger, because it necessitated imperfect ventilation. Now, ventilation meant vigorous life, for all knew the difference between work performed in a confined space and that performed in a roomy workshop. In the pits this was more marked, for there was also found an atmosphere almost invariably at dew point—that was, at its temperature—saturated with watery vapours, and, beside that, it was surcharged with foreign gases, the products of respiration, as well as emanations from the coal seams. Now, if they would consider that in respiration carbonic acid was given off, and that 6 per cent. of carbonic acid was fatal to life, the necessity for its removal would be admitted; but, independently of that, there was the fact that the presence of carbonic acid involved the previous removal of oxygen, which was the supporter of life's processes, for every 6 lbs. of carbon required 16 lbs. of oxygen to convert them into carbonic acid.

He had spent some hours in ill-ventilated pits, and could scarcely call to mind having experienced elsewhere such a depression of spirits and exhaustion of bodily power as takes possesion of one if breathing long in such an atmosphere. Some of these pits had been purposely prepared for his experiments, at great inconvenience to the owners or managers, but from his experiences he had become convinced of the necessity of improved ventilation. It might, indeed, be well worth the while of members of that association to give their attention to the subject, for the present means of effecting it were very far from being perfect. The men did not like a draught, but they did like an atmosphere which was moving slowly, so as to continuously sweep out the foul gases, and yet not lessen their artificial lights, for light to the miner meant so much money gained per diem. Some plan, other than any at present adopted, would one day be devised, by which the fouled air would be at once removed and fresh air be introduced. At such a period we should hear no more of explosions of fire-damp. Until such a plan had obtained, he was obliged to confess that the miner should be protected from himself, even if it were against his will. He would mention that in the pits draught does not give cold as it would do on the surface, because, although one perspired there very freely, no evaporation took place from the skin, because the surrounding air was already saturated with moisture, and it was this circumstance which caused such profuse perspiration to those who remained long in the galleries of a coal mine. The owners and managers, as a body, took great precautions against accidents of all sorts, yet there were some who, from parsimony as well as from poverty, managed their collieries so closely as that they just avoided accidents for a time, but presently came a crash, and then the whole body was blamed, as he (Mr. Ansell) considered unjustly. Without wishing to give offence to the owners of other pits, he might say that the Hetton collieries, the Wigan collieries, those at Staveley, and the Oaks pits at Barnsley, were almost palaces of mines. In those pits, which he had recently visited, he had seen such mechanical appliances used, and such extreme care habitually taken, that accidents occurring therein must be considered as legitimate accidents. The men in almost all collieries, knowing danger to be their normal condition, seemed to get accustomed to such a state of things, and became, unless in exceptional cases (and in these cases the men were sure to rise to high positions in the pits), careless, and, indeed, seemed to invite destruction. It might seem ungenerous on his part to say this of them, but they freely ran the risk of committing wilful murder on a large scale, and frequently, through their careless wilfulness, sacrificed many lives for the gratification of enjoying a pipe of tobacco. Others, with the more reasonable excuse of obtaining increased light, removed the safety-caps from their Davy lamps, and thus exposed themselves and others to great peril. He was free to admit that there was great apathy on the part of some coalowners as regarded the introduction of new inventions for saving life. It had been said by a very discreet man, and one who had devoted many years to the subject, that "owners, engineers, and miners, must be educated before they will be induced to adopt scientific plans for the protection of life." In his own experience he had met with owners who were opposed to improvement, and objected to his proposition for the indication of fire-damp. That he might not be thought to venture upon this statement from thoughtlessness, he would remind his hearers of the apathy, if not neglect, with which the Davy lamp itself was, and still is, regarded. Many persons even now argue that it has caused more deaths than it has saved lives, and that mines are better, therefore, without it. It was necessary that he should briefly explain the principles of the Davy and Stephenson lamps, and the nature of their new form, when both were combined, as in the Stephenson-Davy lamp, now coming into general use in certain districts. This lamp consisted of an oil-containing vessel, with a wick, and a small bent wire for the trimming of the wick. The wick and its trimmer were enclosed in a wire gauze, which itself contained a glass chimney, surmounted by a perforated copper cap. The action of this lamp was dependent on the fact that flame cannot pass through a tube of a certain dimension, because, in its passage, it was reduced to such a temperature that it ceased to exist. The flame was fed with air which entered through small holes pierced through the brass which carried the gauze wire, and the products of combustion escaped through the perforated copper cap at the top of the chimney, and thence through the wire gauze. This lamp, in his (Mr. Ansell's) opinion, was not so useful for testing for fire-damp as the simple "Davy," because one had not the opportunity to witness the changes in the flame caused by the various mixtures of gas, but it was better for the miner, because it would go out if the atmosphere became explosive from the presence of fire-damp. It was a better illuminator than the other, while, at the same time, it formed a double safety-lamp, by reason of the combination of the two forms.

The Davy lamp gave less light, and was more liable to be extinguished by accidental causes; but was far preferable, in his opinion, as a test lamp for the presence of fire-damp. Still it was somewhat dangerous, for there were many instances of difficulty in extinguishing the flame of the gas when it ignited within the gauze, and men have been obliged to bury the lamp in ashes or small coal, and thus exclude the atmosphere, before the mass of flame could be got rid of. A red-hot lamp was dangerous for two reasons—firstly, because the wire gauze was apt to drop in pieces; and, secondly, because particles of organic matter, or of coal dust, might be ignited against it, and so fire the explosive atmosphere outside.

The Clanny lamp was used in some districts—indeed, it was curious to observe how fashion seemed to prevail even in such matters. This lamp was not a safe lamp. He was recently in a coal pit with some other persons, and they all had Clanny lamps. The glass of one of the lamps cracked from top to bottom, as it was apt to do at all times, from the heat. No explosion occurred, but had the glass been under tension, and at the time of cracking sprung open, so as to leave a crack as wide only as a sheet of paper is thick, an explosion would, probably, have resulted. Besides this risk, the glasses seldom fitted well, and frequently very badly. The "Clanny" was better in one sense, and that was in its emitting more light than that from either of the other lamps named. These explanations, coupled with the experiments shown, Mr. Ansell hoped would make the lamps tolerably understood, and he did not think it necessary to describe other safety-lamps, their number being very great.

There were many reasons for saying that the present means for protecting the mine from fire-damp were not sufficient. Ventilation was not carried, in all cases, to such perfection as to do away with all evils, nor were the beautiful safety-lamps safe if overworked. The intention of the inventors was that the men should be protected for a short time if by chance they became involved in an atmosphere of an explosive nature. Until the lamps were placed in an atmosphere which was half way between safety and danger they gave no warning. He was, therefore, of opinion that his own proposition would one day be esteemed, because by its agency a man would tell if there were any excess of fire-damp. He would illustrate his meaning thus:—There might be from 4 to 5 per cent. of fire-damp present, and yet the safety-lamp would give no warning of its presence, and which, indeed, was the case recently in a pit in which he had been engaged. His indicator in this instance showed clearly 5 per cent., yet the lamps made no sign of its existence. In other pits the lamps had, however, shown 3 per cent. The explosive point of fire-damp commenced at $7\frac{1}{2}$ per cent., was most violent at $10\frac{1}{2}$ per cent., and ceased at 15 per cent., when the mixture burns. Therefore, we had got near the minimum point of explosiveness. He was quite aware that in such a pit as he had spoken of it was illegal to work with naked lights, and that safety-lamps were supplied; but were there no cases of good laws evaded by over-anxious miners or careless boys? Otherwise, how could some of the recent explosions have been effected? In such a case he maintained that his instruments would warn the men, and inform the underlooker of the real state of the case. He could mention cases, but that was not his aim. It was the principle that he was now speaking upon. The gas commonly accumulated under the roof of the gallery, but he had recently seen a case in which the whole "return" air contained 5 per cent. of gas. In a pit such as this, making gas at every foot, it was no difficult matter to imagine that an accident might cause less ventilation at some particular spot, and in such a case at the spot the upper strata would quickly become explosive. Such cases were not uncommon, for there were many, very many, mining engineers and managers who had themselves either exploded pits, or been present at explosions. It was not for him to point out where instruments should be placed; that belonged to the practical man in the pit, but that they could be advantageously applied admitted of no doubt, although their universal adoption might be reserved for another century. He would now proceed to explain the details of his proposition, and to show its character by experiments. Mr. Ansell then introduced several varieties of his ingenious apparatus, the action of which, as our readers know, depends upon the law of gas diffusion. A very small percentage of coal gas playing upon a marble disc speedily diffused through the marble, and set in motion an alarum. Upon the same principle all his experiments were based, and the results astonished and delighted those who witnessed them.—In submitting a vote of thanks to the meeting, after some discussion, in which Messrs. Edmonds, Dalziel, Briggs, Sanson, Lax, and others joined, Mr. NEWTON eulogised the inventor of the Fire-Damp Indicator, and finally the vote to Mr. Ansell was carried unanimously.—The members then separated.

THE CHEMISTRY OF COAL AND FIRE-DAMP.

It is scarcely possible to conceive a more interesting sketch of the immense advantage to which Science has turned the volatile products of coal, in connection with our national manufacturers than that given in Dr. CRACE-CALVERT'S Cantor lectures, delivered before the Society of Arts, although the almost repulsive title, "On the Synthesis and Production of Organic Substances, and the Application which some of them receive in Manufactures," may have caused many to pass them by altogether, as something unlikely to suit the taste of any but the most enthusiastic scientist. But, in truth, they are what they profess to be—a continuation of last year's course, showing the necessity of studying chemistry, not only as a separate branch of learning, but in its obvious and intimate connections with nearly every other class of scientific investigation, such as physiology, geology, mineralogy, agriculture, and natural philosophy.

The volatile products from coals were, as Dr. Crace-Calvert observes, first employed as an illuminating agent. Science and application have gradually brought that illuminating agent to a high state of perfection, and have shown the most economical way of employing it, and the best means of availing ourselves of its illuminating power without interfering with the health and lives of those by whom it is used. Thereby a cheap and effective illuminating agent has been secured to society. At the same time as these volatile and gaseous products are generated, water containing various substances is produced, and science having ascertained their nature, we find them converted into alum, sulphate of ammonia, and other commercial products extensively used in agriculture and in manufactures. Further, a dark, noisome, sticky product, called tar, is also extracted, which at first used to be the great hindrance to gas-light manufacture. This product having been examined and studied by chemists, a most valuable series of substances has been gradually extracted and applied to useful purposes. First of all we have pitch, used most extensively for making smooth, clean, and pleasant footpaths, promenades, and even roadways. Some of the oily products which pass off are used to preserve the sleepers on our railways, and other materials used in building which it is desirable to preserve from decay. Another solid substance, paraffin, is also obtained, which is now extensively used as an illuminating agent, and, when mixed with oils, as a lubricator. It has also of late been employed with marked success by Dr. Stenhouse, as a substitute for caoutchouc, for preventing the permeation of damp or wet through fabrics. In addition to these, more volatile products are obtained, which were first applied to dissolve caoutchouc and other materials of the same class, and which, in their turn, were applied to a number of useful purposes. The chemical composition of these volatile products having been further studied, means were devised for obtaining, by chemical transformation, a series of colours, rivalling in beauty, in cheapness, and in facility of application, any dyes which were previously known to the world. Lastly, from coal tar or from coals a most powerful antiseptic agent is obtained, the value of which has been lately demonstrated in the cases of the cattle plague and the cholera. The properties of this substance have not yet been fully ascertained, but in course of time it will prove to be one of the most important yet discovered, owing to its powerful antiseptic properties, for we may consider most of the ailments and diseases of mankind as derived from the decomposition or decay of some of the tissues, and it therefore follows that in all diseases or decay whose source can be traced to the decomposition of organic matter, carbolic acid must undeniably be the most effective remedy. The perfect knowledge which chemists have obtained by analysis of the relationship of composition which exists between organic substances has enabled them of late years to produce artificially, or convert substances one into another, which they never could have succeeded in doing had they not had a clear insight into the composition and properties of substances under examination, as compared with those they wished ultimately to reproduce.

Dr. Crace-Calvert then proceeded to call attention to a gaseous compound called acetylene, or the richest carburetted hydrogen known, for it contains four atoms of carbon for two atoms of hydrogen. Although this product always exists, but in small proportions, in common coal gas, still Mr. Berthelot asserts, and no doubt with truth, that its presence increases materially the brilliancy of common coal gas, owing to the large proportion of carbon it contains, and which by floating in the flame radiates light, and thereby increases its brilliancy. This substance is characterised by giving, with a solution of protochloride of copper dissolved in ammonia, a beautiful coppery precipitate, which is highly explosive. Actylene, also, when mixed with chlorine, and the mixture is exposed to the action of light, or to any flame containing chemical rays, such as those produced by the combustion of magnesium or sulphuret of carbon, gives rise to violent explosions, with the production of hydrochloric acid and a deposit of carbon. This fact should be noticed, as it will be, further on, a means of distinguishing this substance from another one, which is the chief illuminating agent of coal gas, and called ethylene, or heavy carburetted hydrogen. This substance (acetyline) does not exist merely in coal gas. Mr. Berthelot has proved it to exist in a great number of instances, and to be a constant product of the slow combustion of most organic substances. Further, this substance offers to us a peculiar interest, for it is the first ever produced by chemists by the direct union of carbon and hydrogen. Up to the time of this discovery chemists were acquainted with a great number of carburetted hydrogens, either obtained naturally from the organic kingdom, such, for example, as otto of roses the essences of lemon, bergamot, cloves, neroli, and the solid substances called caoutchouc, gutta-percha, as well as a great number of others obtained through the destructive distillation of organic matters, as well as coals, such as ethylene, amylene, caprolene, propylene, &c. Mr. Barthelot succeeded in obtaining acetylene (as was shown at the end of the lecture) by passing through a glass globe a slow current of hydrogen gas, in which globe there were the two carbon points of an electrical battery in a state of incandescence, producing what is usually called the electrical light. Under this intense heat and electrical current, the hydrogen introduced by him combined with the carbon of the points and produced acetylene, which he collected by passing it through an ammoniacal solution of protochloride of copper, getting a coppery precipitate, or acetylide of copper, from which he easily isolated acetylene, thus proving to the chemical world the possibility of the artificial production of a carburetted hydrogen. This discovery, which astonished the scientific world, was soon followed up by a series of most interesting facts. Mr. Berthelot having placed in a small flask, to which was attached a tube allowing the exit of any gas which might escape, some acetylide of copper, together with zinc and ammonia, and on heat being applied a chemical reaction ensued, by which two atoms of hydrogen were added to acetylene, converting it into ethylene or heavy carburetted hydrogen, also called olefiant gas, which is exceedingly interesting, owing to its being the chief illuminating element in common gas, and is characterised by burning with a bright flame, with no deposit of carbon, like acetylene, and when mixed with one equivalent of chlorine, and the mixture left to itself for some time, the chlorine unites with the olefiant gas, producing the oily fluid called Dutch liquor; but when mixed with two volumes of chlorine, and a lighted taper brought in contact with them, hydrochloric acid is formed, and carbon is deposited; further, it is absorbed slowly by sulphuric acid, whose property, we shall see presently, Mr. Berthelot has most judiciously availed himself of to convert it into an organic substance. The olefiant gas, though existing in large quantities in common coal gas, cannot be isolated, owing to the numerous compounds with which it is mixed. Therefore, it is necessary to adopt some chemical reaction to produce it in a pure state when it is desired to investigate its properties. To attain this end, one part of alcohol is mixed with three parts of vitriol or sulphuric acid, and on being applied each chemical equivalent of alcohol loses two equivalents of water; the remaining element of that alcohol, being olefiant gas, is liberated and can be examined. What gives interest to this chemical reaction is, that whilst you thus separate, under the influence of heat, alcohol into olefiant gas and water, you will, if we follow Mr. Berthelot's process—of placing at the bottom a large glass globe, a small quantity of concentrated sulphuric acid, and filling the remaining portion of the globe with olefiant gas, keeping the same in a constant state of agitation—after having imparted to the vessel some 40,000 or 50,000 rotatory motions, find that the olefiant gas has been absorbed by the vitriol; that it will have fixed two equivalents of water; and that it will have thus converted the olefiant gas into alcohol, which can be isolated by subsequent chemical manipulations. Therefore, from carbon and hydrogen we first produce acetylene; this substance we have converted into olefiant gas, which in its turn has been transformed into alcohol, which alcohol you can easily convert into ordinary ether, or into acetic ether, spirit of nitre, or nitric ether, &c.; or you can also, by oxidising, convert it into a substance called aldehyde. To convert alcohol into ether, all you have to do is to remove from alcohol one chemical proportion of water, and the elements which remain—one of olefiant gas and one of water—constitute ether. We can still further pursue these interesting transformations. For if you add four proportions of oxygen to olefiant gas, or if you act upon alcohol, by means of platinum black, or, as I have lately discovered, by means of charcoal in presence of an excess of oxygen, you will convert alcohol into acetic acid, or vinegar. It, therefore, follows that, from carbon and hydrogen, mineral elements, a great number of organic substances can be produced. In fact, from acetylene the following series of compounds have been obtained:—Acetylene, $C^4 H^2$, can be transformed into ethylene, $C^4 H^4$; into aldehyde, $C^4 H^4 O^2$; into acetic acid, $C^4 H^4 O^4$; into glycollic acid, $C^4 H^4 O^6$; oxyglycollic acid, $C^4 H^4 O^8$; and oxalic acid, $C^4 H^2 O^8$. Mr. Berthelot has also demonstrated the possibility of producing organic substances from mineral elements. The starting point of this series is a gas well known by name to all. It is called "fire-damp," owing to the fact that it exists more or less in all coal pits, and that when it is liberated in large quantities, and gets mixed with the atmosphere, it produces a most explosive mixture, the result of which is the destruction of thousands of lives in this country. This gas also bears the name of marsh-gas, from the circumstance that it is a constant product of the slow decay of organic matter. In fact, some 20 or 30 years ago, when a lecturer wished to illustrate the properties of this gas, called also light carburetted hydrogen, as compared with olefiant gas, which is called heavy carburetted hydrogen, his assistant had to proceed, as I have done myself, into marshy districts, and, by stirring up the mud, collect the few bubbles of gas that escaped from the swamp. This operation (to collect gas mixed with impurities), which was far from agreeable when it had to be done in January or December, has been obviated through the progress of chemistry. Some twenty years since, Dumas found that when he heated in a retort a mixture of dry acetate of soda with baryta, a gas was generated which was marsh-gas, resulting from the following reaction the acetic acid of the acetate of soda having separated itself into carbonic acid, fixed by the baryta, the remaining element was marsh-gas. But Mr. Berthelot has gone a step forward, and he has succeeded in producing fire-damp, or marsh-gas, direct from mineral elements. He has effected this interesting discovery by passing over some heated copper foils, placed in an earthenware tube, a mixture of two substances—sulphuretted hydrogen and sulphuret of carbon. Under the influence of heat, the sulphur of the sulphuretted hydrogen and of the sulphuret of carbon unite with the copper, whilst the hydrogen of the sulphuretted hydrogen and the carbon of the sulphuret of carbon combine together to produce marsh-gas. This triumph of modern chemistry is most important, for if to marsh-gas you proceed to add two proportions of water, it will be converted into methylated spirit, or wood naphtha, a substance now extensively mixed with alcohol to manufacture the product called "methylated spirit," so extensively employed in England at the present time in arts and manufactures, and which has been the means of removing the duty usually imposed by Government upon all alcoholic liquors capable of being used as a beverage, and enables English manufacturers to produce a variety of varnishes, &c., and to enter fairly into the field of competition with those countries in which alcohol may be considered a cheap article.

UTILISATION OF WASTE SUBSTANCES—"PARKESINE."—Whilst considerable attention is being given to gun-cotton and nitroleum, a somewhat similar substance is gradually making its way as an article of ordinary domestic use, entirely free from danger, and possessing such advantages as are likely to secure its general adoption. In the manufacture of Parkesine, fibrous vegetable matter of any and every kind—cotton and flax waste, and old rags, being, from their cheapness, the favourite materials—may be employed. These are first dissolved by acids, and they then yield what chemists call pyroxyline. Pyroxyline, however, as its name implies, is highly inflammable, and indeed explosive, like gun-cotton, and this dangerous qualification has to be neutralised. Mr. Parkes effects this by the introduction of either of various chemical ingredients, as iodide of cadmium, tungstate of soda, chloride of zinc, gelatines, several carbonates, sulphates, and phosphates. Collodion (as used by photographers), when evaporated so as to leave a solid residue, has been employed in the production of Parkesine, but it was found by far too expensive. The substances which have given the best results with the pyroxyline are nitrobenzole, aniline, and glacial acetic acid. By the use of various proportions of these substances, all consistencies of Parkesine, from the solid to the fluid form, may be obtained. The applications of Parkesine are, of course, as numerous as its forms are various. In the fluid form it is available for waterproofing fabrics, and in this way it is very serviceable. In a plastic state Parkesine is useful in making tubes, &c., and for insulating telegraph wires. Where hardness and toughness are required, these desiderata are arrived at by the admixture of oils prepared with chloride of sulphur, which latter solidifies them (the oils) and makes them non-adhesive. Again, by the use of resins, gums, stearine, tar, &c., modified preparations of the invention may be made to suit special applications. Parkesine, indeed, is a most accommodating material, and may be made as hard and brittle as glass, or as fluid and yielding as cream, and of every intermediate consistency. It may have elasticity imparted to it to almost any extent or degree, and in this state it is likely to become a dangerous rival to India-rubber and gutta-percha, inasmuch as it will become, if it be not now, far cheaper than those useful articles of commerce, and answer almost all their uses equally well. Vulcanised India-rubber will find a sturdy competitor in Parkesine, for it may be manufactured with less of brittleness, quite as much hardness, and at a lower cost than that tediously manipulated substance. There is no refuse in the manufacture, the chips and cuttings being capable of re-manufacture with the greatest facility. Parkesine will take any colour, and may be given any degree of hardness; it may be made to imitate tortoise-shell, marble, malachite, or amber, and can be cut with a saw, turned in the lathe, planed, carved, engraved, stamped between dies, rolled into thick or thin sheets, worked into screws, shaped into mouldings or cornices, &c. It is susceptible of a high polish, agreeable to the touch, and not disagreeable in smell. At a temperature of 340° Fah. it is consumed, without flame, being decomposed and passing off as dense smoke, leaving but a dark coloured ashy residue behind. It is now being manufactured for a variety of purposes, and is daily becoming more extensively known.

UTILISATION OF REFUSE SLATE.—The profits of many of the Welsh slate companies inaugurated during the past few years have been frequently much diminished, and sometimes entirely dissipated, in consequence of the large amount of refuse made in the process of manufacture, and there can be little doubt that if this refuse could be turned to account the position of these undertakings in commercial estimation would be materially changed. A discovery, which offers to adventurers in and owners of slate quarries the utilisation of this very refuse, which has hitherto been an inconvenience to them, has just been made by Mr. POTTER, of New York, and no doubt the process will ere long become very general in this country. Any kind of clean slate refuse, although so small as to be worse than useless at present, can now be rendered marketable. The material employed is common slate rock ground to a fine powder, and in that state mixed with mastic or any bituminous substance to the consistency of a thick paint, in which condition it is applied to canvass, cloth, paper, felt, or any similar substance. It soon hardens, and by the action of the elements, or by means of chemical action within itself, becomes so indurated as to be almost as impervious to the action of fire or water as slate itself, though considerably less brittle. The principal constituent of the material is at once cheap and abundant in every civilised country on the globe, so simple in preparation and application that common sense is the only qualification for using it. A mastic, it adapts itself to every shape and condition. Adhesive, it needs no nails or hooks to hold it. Non-combustible, it is not the means of destroying your property, but of protecting it. Impervious, water, nor even steam, cannot penetrate or dissolve it. Repairable, "a little more of the same sort" and a brush or trowel restores it from accidental injuries. Renewable, the waste from the friction of falling water may be returned once in ten or twenty years forever by the use of the brush. This mastic, as will be readily inferred, is a totally different material

rom the ordinary roofing felts and similar materials which have sometimes been roposed, having all their advantages without their defects, one great recommendation of the artificial slate being the intimate mixing and combining of he material, by having the slate first pulverised to an impalpable powder, and n that state brought into contact with the adhesive substance. There are arious other uses to which this material has been applied, such as cement for isterns, tanks, cellar floors, leaky hydrants, pipes, pumps, &c. Inkstands have een made of it while in a plastic state, which have become as hard as stone. t has been applied as a cheap paint to outbuildings, fences, &c., where it prevents decay.

LIMESTONES AND MARBLES.

The desire to turn every particle of mineral to profit becomes greater year by year, yet limestones and marbles have hitherto received considerably less attention than they are entitled to; but the entire subject is very fully treated of in an interesting paper read before the Nova Scotian Institute by Prof. How, of King's College University, Windsor, on the Economic Mineralogy of the province, the previous portions of which have already been referred to in the *Mining Journal*. In Nova Scotia limestones are found in practically inexhaustible quantities in the province, where there is estimated to be a thickness of 13,000 ft. of the various strata comprising the carboniferous system, among which limestones are frequent, especially in the lower carboniferous beds, which, in fact, consist largely of them, and measure 6000 ft. in thickness. This system is developed almost exclusively to the north and north-east of the capital, in which part of the province upwards of eighty beds of limestone are indicated in Dawson's geological map; the rest of Nova Scotia, including the whole western portion and the southern shore, has but two small patches of carboniferous rocks. The limestones have sometimes been thrown by metamorphic action into the crystalline state, and frequently converted under these circumstances into marble, so that many varieties of this material are met with.

The economic value of limestones will probably always be found in the making of lime for washes, mortar and cement, and for manuring, and in their use as fluxes in iron smelting, since the great abundance of excellent freestone will almost preclude their use as a building material except in rubble work and making foundations. As regards the use in manuring, a considerable portion of the agricultural districts in the province lies in the formation affording limestones, and except for special and occasional purposes lime will not be required in their cultivation—but it must find profitable application by the farmers in the rest of the province where lime rocks are absent, or but scantily developed. Notwithstanding the vast profusion of limestone in the province, a good deal is imported from the West Indies, and much lime from New Brunswick. There is no doubt that the native rocks yield, with careful burning, excellent lime, and the cost of it is probably less than that from the foreign rocks. At Windsor, lime will sell at the kiln at 3s. 6d. the barrel, and the price would be lower if there were more demand; as it is, I am told the New Brunswick lime costs more money; for some reason, however, the latter often obtains the preference, as was the case in building the new library at King's College, Windsor, in the neighbourhood of rocks affording excellent lime. A limestone found at Indian Point, Chester, of a deep blue colour, yields a lime which becomes as hard and lasting as a cement: the rock is much valued in Halifax for building up arches of kilns, a situation in which poor limestone crumbles away, while this remains quite hard. The lime prepared from this rock was preferred to that from New Brunswick in building the Wellington Barracks, in Halifax.

Marbles have long been known to exist in various localities, but none of them have been worked. Parrsboro' yields a purplish coloured marble, with green spots of Serpentine. Onslow mountains furnish a chocolate and a red variety; Cheverie, a reddish-brown, with red bands. Pictou county affords several kinds: one of a greenish hue, and among the rest one which is very remarkable. It is of a grey colour, and when polished shows concentric waved bands covering the entire surface in beautiful markings. Cape Breton has large deposits, there are known a white marble with blackish veins, a black with white veins, and a white and deep green variety, which is very handsome. All the specimens at present met with are from the surface. The deposit of marble which is best known is that at Five Islands, in the Basin of Mines, where it forms large beds in the metamorphic rocks; the marble is of excellent grain and of a fine white colour, surpassing in beauty, when polished, according to Messrs. Wesley and Sanford, the Italian marble. A material may be mentioned here which may prove, under certain circumstances, a useful substitute for marble—the hard plaster or anhydrite, which is found abundantly, and could probably be obtained in blocks of any useful dimensions. It occurs at Falmouth and St. Croix of a white colour, at Windsor of a bluish tint, and also a mottled white; at Parrsboro' a purple rock is met with, and, no doubt, it presents other varieties elsewhere. Its greatly superior hardness at once distinguishes it from the ordinary plaster. It is used in this neighbourhood (Windsor) in building the foundations of houses. Since sulphate of lime (the chemical name for plaster) is not insoluble in water, polished surfaces of hard plaster would lose their lustre in the open air, and the material can only be used when cut and polished in in-door work; under these circumstances it may prove more durable than marble, which is said to be so subject to change from variations of temperature that the mantle of a chimney-piece immediately over the fire is invariably in a crumbling condition long before the sides or those parts which are not so exposed to heat.

SODIUM-AMALGAM EXPERIMENTS.—The results obtained with sodium-amalgam in the extraction of gold from the ores of Nevada would seem to indicate that the failure and abandonment of the sodium process in Wales have been caused as much by the want of experience on the part of those using it as from the shortcomings of the process itself. The Nevada trials have given equivocal results it is true, yet they have proved that additional loss of the precious metal does not always attend the use of sodium-amalgam, and that in some cases there is a positive advantage in using it. In a letter to the American *Journal of Mining*, Prof. Wurtz publishes a communication from Mr. Gideon E. Moore, of the Gould and Curry Mill, Nevada, which states that experiments were made with sodium prepared for that purpose at the laboratory of the Gould and Curry Assay Office, before any of the metal could be purchased in California. They were intended to form part of a thorough and systematic enquiry into the merits of the process. But, after two experiments had been made, the preparation of the sodium was found to be so troublesome, and to interfere so seriously with the current work of the office, that the experiments were discontinued until the metal could be obtained from other sources. It was also found impracticable to conduct the experiments in the pans used for the general mill work, and it is intended to put up a couple of pans of the largest size, in a room separate from the rest of the mill, for that express purpose. The first of the two experiments was made in the Varney pan, heated with steam, and with no chemicals. The result was highly satisfactory, showing a gain in metal extracted of about 20 per cent. over the ordinary process, while the amount of mercury lost was about the same. The second experiment was made in the Hepburn and Peterson pan, using no steam or chemicals. The result in this case was unsatisfactory, showing a smaller yield than by the ordinary process. Prof. Wurtz says that the most important comment he has to make is that he expects on repetition of the first experiment with the steam-heated Varney apparatus to better the results still further, on the ground that some loss of quicksilver (that is, of pasty and floured silver amalgam) is implied to have still occurred; whereas he has always found it easy, with a little practice, to recover all the floured amalgam from a pulp, strictly without any loss. He wishes also to remark that the result with the Hepburn pan, being merely a negative result, cannot be justly regarded as arguing anything but absence of some condition to success, which would, probably, be easily discovered by a little further experiment.

PEAT AS STEAM-FUEL.—At a recent meeting of the American Polytechnic Institute a specimen of patent fuel, of which peat was the basis, was exhibited. The manufacturers, Messrs. LESTER and HALSTEAD, stated that it had twice the heating power of anthracite, taking bulk for bulk. It had 13¾ per cent. greater specific gravity than anthracite, and while ordinary anthracite left 18 to 40 per cent. ash, the patent fuel never left less than 3, nor more than 6 per cent. Besides this, there is a great saving in stowage, on account of the square blocks. Thus, a steamer which now carries 1200 tons anthracite, in crossing the Atlantic would save half the space now taken up by coal, and carry in lieu thereof paying goods. They observed that they had made above 1300 speculative trials, were themselves perfectly satisfied as to its success, and were constantly burning it under their small boiler at Trenton, New Jersey, where it started the engine in seven minutes. It had also been used during a run of 40 miles by a steamer on the river, when the saving of kindling-wood, usually employed in starting the anthracite, came to more than the cost of patent fuel. It is composed of—peat, 60 to 65 parts; anthracite dust, 20 parts; coal tar, 10 parts; and asphaltum, 5 parts; but varying in proportion for different purposes, whether metallurgical, domestic, or other. The peat, dug in the usual manner, is laid in the air to dry; and when dry enough to be mixed with the other materials into an amalgam it is put into a press, and with one blow compressed. It is ready for use as soon as made.

MANUFACTURE OF ILLUMINATING GAS AND OIL.—The invention of Mr. G. M'KENZIE, of Glasgow, consists in combining coal with shale oil or other mineral oil, and in subjecting the mixture to distillation or decomposition at various heats. By the term "coal," he denotes the various kinds frequently termed "bituminous coals" but does not include "lignite," "brown coal," nor "anthracite," whilst he remarks it will probably not be found economically advantageous to employ the varieties commonly known as "gas coal" (except, perhaps, mixed with inferior coal) in working his invention. In practically carrying out his invention for the purpose of obtaining illuminating gas in the manner which he at present believes to yield the best results, but to the precise details of which he by no means restricts himself, he combines the coal and oil in the proportions of 30 gallons of oil to 1 ton of coal; he prefers to have the coal and oil as free from water as possible, and either to take coal already existing in a pulverised state, or as separated by riddling or sifting, or to reduce the coal to a pulverised state by grinding. He combines the oil and coal by intimately mixing the oil with the pulverised coal in any convenient way, preferring to make the combination with the oil, or both oil and coal, in a heated state. It is not essential, however, that either oil or coal should be heated when being mixed. The mixing may be effected in a mixing or grinding mill, such as is used in grinding mortar or loam. He does not restrict himself to any particular kind of mineral oil, but he prefers to take crude shale oil or petroleum, and if such oil as purchased or as manufactured for the purposes of his invention contains volatile oils or water, he prefers to remove these by distilling them off or otherwise before combining the oil with the coal. When the oil is heated for such a purpose—that is to say for removing the volatile oil and water—then he at once combines it with the coal without allowing it to cool. In some cases, the residue known as "bottoms," obtained in treating crude shale oil in the existing processes of manufacture, and which is left in the still after distilling off the "light" and "lubricating" oil, may be mixed with the crude oil employed in carrying out the invention, with the view of reducing the aggregate cost of the raw materials. His improved gas compound, prepared in this manner, is treated for the obtainment of illuminating gas, precisely like the ordinary gas coal used for that purpose—that it to say, it is put into the gas retorts of iron or fire-clay, such as are at present in use, and the distillation or decomposition is effected in the ordinary way, it being necessary to remark in connection therewith merely that it is advantageous to employ a strong heat, never less than a bright red heat, but a white heat, or nearly so. A carbonaceous residue or coke is left in the retort, as with ordinary gas coal, and being of good quality will by its use or sale reduce the cost of the illuminating gas.

HINTS TO EMIGRANTS—No. V.

BY CHARLES S. RICHARDSON.

Let us suppose you have determined to try your fortune over here with a view to a permanent settlement: now, my advice is that you should come out alone, or bring one or two stout boys with you. Leave your wife and young children at home, because if you should not be successful in immediately effecting a purchase, or in procuring labour to suit you, you will have to travel further on, which would be very expensive, as well as inconvenient, to take a whole family about with you: besides, a residence of a few months will not only enable you to make a proper selection, but you may save enough money to help you bring your family over, and procure such articles for domestic use most suitable to the country. If you are a miner or a collier, I would suggest your going to Pittsburg or Wheeling districts, although for permanent settlement Pomroy or Kanawha would be best, for the latter is destined ere long to become the greatest bituminous coal, cannel, and oil producing district in the United States, all the lands of which are rising rapidly in value. But if you are a carpenter, mason, bricklayer, quarryman, smith, or labourer, you should stop at Parkersburg. This is a young town, growing fast into a city. All trades are wanted here. Last year over 400 houses were erected, and a much larger number are in progress this. Several factories are in successful operation, and others are being built: they consist of steamboat and barge building yards, saw and planing mills, cooperages, machine shops, and foundries, oil refineries, &c. Parkersburg is the emporium of the oil trade of the State; it lies at the confluence of a small stream, called the Little Kanawha, with the Ohio. It is, however, a misnomer, for it has no connection, nor is it within nearly 100 miles of that noble river, the Great Kanawha. Parkersburg is the terminus of the north-western branch of the Baltimore and Ohio Railroad, and, therefore, commands the advantages of the Ohio river trade and that of the railways on both sides of the river. Half-a-dozen steamboats leave every day for different ports on the Ohio, both above and below, and it is fast becoming a place of importance, already having four banks, six churches, extensive wharves, and 9000 inhabitants. My connection with the oil and mining interests compels me to spend much of my time in and around this place, therefore I am familiar with the wants of the place and the people. Everybody appears to be doing well. I do not know of a single person unemployed who has any desire to work. Wages are good, and the cost of living is at a fair average rate, but, in consequence of the scarcity of houses to let, rents are very high, and it is difficult to get a house in or near the town. I would advise persons coming here to obtain employment at the oil wells, which are from 15 to 30 miles distant, or on some of the new works in the town. Wages may be estimated at about the following rates, according to quality:—Boys from 16 to 18 years of age, 1*l.* 1s. per week; strong, handy labourers, 1*l.* 15s.; ordinary mechanics, 2*l.* 10s.; superior workmen, 3*l.* 5s. The boarding houses charge from 16s. 6d. to 1*l.* 5s. per week. Hotel living is very dear, the lowest being 1*l.* 19s., and the highest, which is the Swan House, 7*l.* 7s. per week. This hotel is a fine establishment, and the chief resort of the mining and oil well agents, speculators, and first-class visitors. It has an electric telegraph office on the premises, from whence telegrams may be sent to all the oil districts, as well as every part of the States, a convenience somewhat unusual for a country town, but very valuable to the guests. For two rooms in a tenement house, 1*l.* 13s. 6d. per month will be asked, or 6*l.* 10s. for a four-roomed cottage. The superior class of houses are not so high in proportion to their value as the dwellings of the working men, which I suppose is the custom everywhere, for poor people always pay most. Now, these figures only relate to town or city rates; in the country villages and hamlets they are 50 per cent. less, and wages about 30 per cent. lower, except around the oil wells, where both are about the same as in the town. Provisions and domestic articles of ordinary family use may be quoted at about the following prices:—Flour, 3d. per lb.; bacon and pork, 9½ per lb.; beef, 8½ per lb.; potatoes, 7s. per bushel; cabbages, 6d. each; tea, 8s. 6d. per lb.; coffee, 2s. 3d. per lb.; brown sugar, 10d. per lb.; loaf sugar, 1s. 2d. per lb.; rice, 8d. per lb.; candles, 10d. per lb.; lamp oil, 2s.; butter, 2s. 3d. per lb.; lard, 10d. per lb.; cheese, 1s. per lb.; dried fruit, apples and peaches, 4d. to 6d.; tobacco, 2s. per lb. Clothing is very dear. Good strong men's boots, 1*l.* 7s. 6d.; women's, 16s. 6d.; felt hats, 12s. 6d. to 1*l.* 5s.; white calico, 1s. 3d.; prints, 1s. 8d.; flannels, 2s. 6d.; sheeting, 2s.; fustian, 6s. 6d.; corderoy, 7s.; kerseymere, 16s. 6d. These are all common articles, but the careful housewife will know from the prices quoted how to estimate the cost of keeping a family, and the husband, who with his own and boys' work added (sickness or accidents excepted) can easily calculate how much money he can save by working 280 days in the year.

Now, my friends, I do not advise you to remain long in the towns. If your inclination leads to a rural occupation you must look about the country for a small farm, either to rent or purchase. There are occasionally farms to let at about 3s. per acre, but the usual custom is for the landlord to take one-third the nett produce for the rent, in lieu of money, it being more convenient for the tenant also to pay in this manner, for every dollar he can get he wants to invest in stock, or if the land is his own, to the improvement of his farm. Back woodland farms may be obtained by paying a small deposit, and a term of years allowed for the remainder. For men of small means I would direct their attention to the cheap lands of Roane, Gilmer, Calhoun, Clay, Braxton, or Kanawha ounties. Many of these may be purchased at from 1*l.* 10s. to 3*l.* per acre, with perfect wa rranted titles, and direct from the resident landowners. Some of them are partially cleared, and may be put into immediate cultivation; some of them were abandoned at the outbreak of the rebellion, and are now much overgrown with brambles, the houses on them gone to decay, fences broken, and in some instances entirely destroyed; but these are easily repaired. A good five-roomed log house, with stone chimney, will cost 30*l.*, and fences about 1s. per rod. Persons in the country will build these for you before you move your family on to the land, if you desire it, and those who can afford to do so will find it a great advantage, for a houseless farm is a dreary aspect for a woman, with half a dozen young children to take care of, especially to those who know nothing of the vicissitudes of a forest life.

There are three considerable rivers and several large creeks traversing these counties, over which, during the autumnal and spring freshets, timber, lumber, and other produce is rafted down to the Kanawha on one side, and to the Ohio on the other. The country here is about three-quarters still primitive forest, but when brought into cultivation may be computed to comprise about the following proportions:—Tillageable land, 25 per cent; pasturage, 50 per cent.; permanent woodland, 25 per cent. At present there is not more than 15 per cent. under direct cultivation in any shape; the settler may, therefore, see that there is plenty of hard work for him in view; but, as a set off against this, the very woods he is clearing to make his farm will afford him a livelihood while he is about it, for many of these lands will produce 600 cubic feet of timber to the acre, consisting of white oak and tulip poplar, for which he can obtain a ready sale at 9d. per foot, averaging about 12*l.* per acre. There is an enormous demand for coopers' stuff, such as flour and oil barrel staves and hoop poles, also ship timber and shingles, for which most excellent prices are given. These articles are all made in the woods, and rafted down the rivers during the freshets, so that the man and his family are provided with constant employment in the interim between harvest and the spring seed time. In fact, an industrious man in these central counties never knows what it is to have a leisure day. Now, some persons on looking at this picture may say it presents a poor prospect for a man to get rich on. Riches seldom fall to the lot of the poor hard-working man: I am only pointing out the way to competence, not riches. I affirm such can be, and yearly is, attained by hundreds of steady, persevering men in this and the adjoining States.

VISIT TO THE QUICKSILVER MINES OF IDRIA.

These mines are the property of the Austrian Government, who appear, although they do not pay high wages, to take very great care of the workmen employed there. These are 600 in number, of whom 200 are engaged upon the works on the surface, where the mineral is extracted from the ore, while the remainder are employed in the mine itself. The buildings connected with the mine are good, and well kept. The posts and doors are painted with the familiar black and yellow, and the Austrian arms, surmounted by two crossed hammers, are affixed to the various offices. The Government has erected a theatre for the use of the workmen, and appears to study their comforts in a manner for which its habitual detractors would hardly have given it credit. The pay of the miners is about 8d. a day—apparently a very small sum, but which is above the average gain in a country where the necessaries of life are extremely cheap. When ill—which is not unfrequently the case, for the fumes of mercury are extremely deleterious—they receive 6d. a day, together with medicine and medical attendance, and are provided for in old age. The formation of the country where the mine is situated in an oolite limestone, known as Jura limestone. I made a careful examination of the surface in the neighbourhood before entering the mine, but could discover no signs of the existence of a mineral vein, and was, therefore, at a loss to imagine what induced the original investigators to set to work at that particular spot. I find, however, that a spring which arose there had been observed to deposit in its hollows small quantities of quicksilver, and a merchant from Trieste, who happened to be stopping at Idria, concluded from this that by sinking to a sufficient depth the source from which the spring drew the mercury would be discovered. He, therefore, obtained a grant from Government, and began the work, which he carried on for years with success. It was evident, however, that a much greater depth must be attained, and to do this a larger capital than he was able to command was required. He, therefore, sold the works to Government, by whom they have been carried on ever since. They are now the most extensive and rich of any in Europe, with the exception only of those at Almaden, in Spain. Being furnished with a guide, and having put on the suit of miner's clothes provided for visitors, I commenced my descent. This was made by a number of inclined shafts of excellently-constructed masonry, of a perfect oval, and about 7 ft. in height, and which can best be conceived by imagining a London sewer placed nearly on end. In these shafts are small stone steps, by which the descent is made without fatigue or difficulty. My experience of mines is very extensive, and certainly these shafts are superior both in arrangement and workmanship to anything similar I have ever witnessed. The mine is worked in five levels. In some places the quicksilver occurs in glistening globules in a soft and partially decomposed state, but the greater portion occurs in the limestone itself, in which even where present in a proportion of 80 per cent. it is not visible, but the ore resembles very rich brown hematite ironstone. The atmosphere in the mine is warm, with a close mineral odour, and in some of the rich places the miners are unable to work for more than two hours at a time, owing to the deleterious mercurial fumes. The timbering, ventilation, and other arrangements of the mine are good, but I never saw labour so completely thrown away in any undertaking of the kind I ever visited. The miners were constantly employed upon poor barren looking stuff, which the most unpractised mining man could have seen was never likely to lead to anything. Had their work taken the shape of small galleries for exploration, it might have been explicable, but they were almost all engaged in greatly widening previously made passages, where nothing whatever had been previously found, and where there was not the slightest probability that the work could be of the least utility. I can only account for it by supposing that as a miner can only work for a few hours a week upon the rich spots, and as the managment are, therefore, obliged to keep a large succession to work continuously at these parts, they put the men at the unlikely places purely to keep them employed. The total depth of the mine is 140 fathoms. I made the ascent in a large and very dirty bucket, by which the ore is lifted to the surface by a nearly perpendicular shaft, worked by water power.

The works for the extraction of the quicksilver from the ore are situated at a distance of about a mile from the town, but the furnaces are not at work at this time of the year, as the fumes are so extremely deleterious that all vegetation, and the cattle which feed upon it, would be greatly injured by it. The process is, therefore, only carried on in winter, when the fumes fall upon the surface of the snow, and are washed away when the thaw comes in the spring. The poorer ores are crushed under stamps, and the mineral is separated by dressing and shaking tables, while the richer stuff is at once carried to the furnaces, where it is roasted, and the mercurial fumes which are evolved by the process are collected in adjoining chambers. It is evident that this must be very imperfectly carried out, or the fumes which spread over the surrounding country would be far less noxious than they are at present. The total amount produced annually is about 2500 centners, each centner being 100 lbs., of which the great proportion is exported in iron bottles for the use of the gold and silver mines of Mexico, Peru, and Brazil. Among no class of the population of various countries is there so great a resemblance as between miners. However the peasantry in general may attire themselves, the miner wears a universal garb. He shaves his face, that the dirt and dust which his occupation engenders may be more readily removed when he returns to upper air; and the worker in the lead mines of the island of Sardinia, the Slave from Illyria, the Frenchman, the Belgian, the Cornish, Welsh, or Newcastle miner, are always alike—mass them together, and the shrewdest observer would be puzzled to separate the men belonging to the different nationalities. They wear the same coarse flannel attire, they have the same loosely hung limbs, the same muscular development about the shoulders, and the same weakness of leg. Their faces are uniformly pale and sallow from working in places where daylight never penetrates; they are hard drinkers, strong in their likes and dislikes, very independent, and great sticklers for their rights. Certainly these Idrian miners are more fortunate in many respects than their fellows, for their houses are slugulary large, clean, and commodious.

DOUBLE-ACTING SAFETY-VALVE.—An ingenious design for the well-known double-acting safety-valve—the principle of which, it will be remembered, is to have a fulcrum on each side of the valve—has been patented by Mr. J. R. SWANN, Edinburgh. In Mr. Swann's arrangement the valve-case has a similar case behind it, which encloses a spring secured to a rod, which forms the fulcrum for the valve-lever, whilst the proper pressure is not exceeded. On the weight side of the valve is a second fulcrum, which upon excessive weight being applied enables the weight at the end of the valve-lever to compress the spring, and, opening the valve, suffers the steam to escape. It will be seen, as the inventor very truly remarks, that with this arrangement the effect is that, on the valve being set to carry any regulated pressure (the spring, the valve, and both the fulcra are enclosed, and beyond the reach of the attendant), if additional weight be applied to the *end* of the lever the steam escapes, and he claims that explosion is impossible from over pressure, because the fireman is unable to tamper with the valve, expect by placing a support at the end of the lever to keep it level, and then applying the excessive weight between the valve and the new fulcrum thus created. In some cases Mr. Swann attaches the water-float to the end of the lever, so that when the water gets too low the safety-valve is kept more tightly closed by the spring on one side, and the weight of the float on the other, but he sometimes dispenses with this arrangement.

PUDDLING AND CONVERTING FURNACE.—According to the invention of Mr. T. PRIDEAUX, of Sheffield, the puddling-furnace has at the back thereof a raised surface, inclining upwards from the bridge, provided with openings with valves through which the metal to be treated may be introduced, By this means the pigs get warmed before falling into the bed, which they reach in a liquid state. Two puddling chambers may be arranged to one melting chamber. The air is passed from the atmosphere to the puddling chamber through flues formed in the arch thereof.

PUDDLING IRON.—Mr. J. G. WILLANS, of Bayswater, proposes to employ two puddling furnaces. In the first the iron is simply reduced to a granular state, and mixed with cinder or iron oxide; and in the second a higher heat is employed, and the balling is effected.

IMPROVEMENTS IN CASTING.—When casting is effected in the ordinary manner in sand, the mould has to be re-formed after every casting. To prevent this inconvenience Mr. F. A. M. BOUE, of Versailles, has provisionally specified an invention, according to which he proposes the employment exclusively of cast-iron moulds. These moulds are in two parts, and in order to prevent the rupture of the article cast, owing to the contraction of the metal, he lifts the upper mould box immediately after the running in of the metal; the contraction then takes place freely at the surface of the article, and rupture is thereby avoided. The lifting of the upper mould box is important, otherwise the effect of contraction would act upon the casting, and cause its breakage. In casting hollow or tubular articles it has been observed that the contraction of the piece in course of being cast is exerted from the circumference towards the centre; there is, therefore, no objection to the employment of a metal mould for the exterior of a pipe, column, or other hollow article. But it is different with regard to the inner mould or core; as the effect of contraction is exerted thereon, it is necessary for it to be of a substance which will yield to the effect of contraction of the metal, for if the pipe or other hollow article were cast between two rigid surfaces it would be ruptured. He, therefore, employs an inner mould or core of sand, and runs the molten metal between an outer mould of cast-iron and a central core of sand. The outer mould box is in two parts, connected together by superposition, clamping, or hinges. These improvements are applicable to casting all fusible metals.

ABSOLUTELY PURE IRON.—The iron obtained by heating in the nitride of hydrogen has a silver white colour, is extraordinary ductile, and may be easily cut with a knife. It dissolves in acids without leaving any residue, and is certainly the purest form of iron yet known.

IMPROVED EXCAVATOR.—An improved excavator has been introduced in Iowa, by Mr. BRADLEY, in the working of which two plough-like shovels are propelled through the earth, from 2 to 6 in. below the surface, as regulated by the foot of the driver; a huge revolving hoe comes down and takes the earth behind, up an inclined plane, upon a long revolving apron or elevator, which carries it backward and upward, over the main wheels, till it is near 20 ft. above the ground behind; and there is another transverse apron, adjustable to a rise or fall of any distance, which takes the dirt to wagons, or dumps it outside the track. The whole is drawn by six or eight horses, cutting a trench 3 ft. wide at each advance, and if working at the full capacity designed it will remove from three to four cubic yards of earth per minute, equivalent to ninety men. But if it attains to only one or two yards per minute it will be a great thing.

A SUBSTITUTE FOR BRITANNIA METAL.—An alloy composed of 3 lbs. of lead, 16 lbs. of tin, and 3 lbs. of zinc, is capable of being rolled out into plates for making white ware of superior quality, as a substitute for Britannia metal.

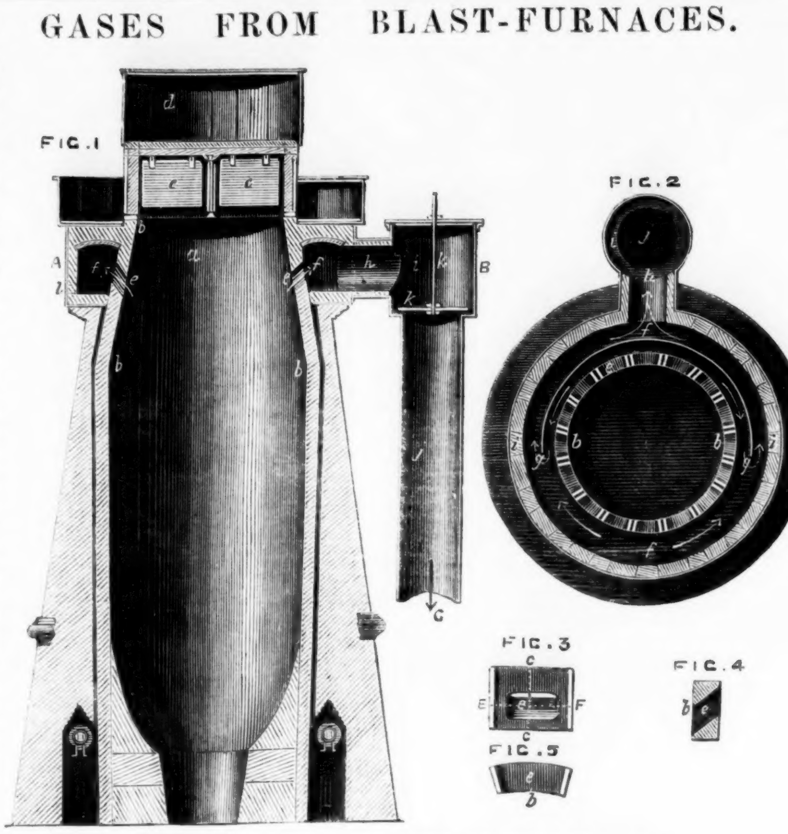
IMPROVED DRESSING MACHINERY.—Experiments recently made in California have shown that the use of dry crushing and superheated steam is employed with great advantage in the separation of gold from its ores. Mr. BRODIE, of San Francisco, has devised an improved wind-blast separator, to be applied to a stamp mill or other crusher, by which the ores are crushed dry, with a large percentage of gain. It is claimed that more work can be done in a given time by dry than by wet crushing, and to better advantage, as the wealth contained in the ore is under control until it is obtained in the form of amalgam. In wet crushing the muddy water carries off a large portion of the fine gold. This apparatus has been tried in Mexico and Nevada. In the latter place a 10-stamp mill was erected at the Boston and Nevada Mine, Austin Reese River, the millwright of which certified that it crushed, into the finest impalpable powder, 13 tons of quartz in 24 hours.

IMPROVED COPPER SMELTING FURNACE.—The water-lined cupola smelting furnace, invented by Mr. HASKELL, of the Buchanan Company's Mine, Chowchilla River, California, has given excellent results. Its merit consists in the water-lining, which prevents its burning out, and requires no fire-brick in its construction; it can be run daily for one year on ordinary ore without needing repairs, it can be placed in running order in a few days after its arrival on the ground; it is simple in its operation, and the heat from the cupola is applied to the boiler, and generates steam for the engine without extra fuel; the consumption of fuel is equal to 1 lb. of charcoal to 3½ lbs. of ore; its capacity for smelting is 20 tons of ore in 24 hours, producing 80 and 90 per cent. copper, according to the percentage of the ore.

PETROLEUM AS STEAM FUEL.—A model of his patent liquid fuel portable grate, for burning petroleum, shale, crude or heavy oil, residuum or grease, creosote, and gas tar, without smoke, has been erected by Mr. C. J. Richardson at the Milrevan Works, Doughty-street, Lambeth. It is to be hoped that some spirited parties will now order a grate, that it may be fairly used, and so introduce the whole system. At present Mr. Richardson is convinced that any substitution for coal as steam fuel on a large scale is impracticable with us; he is, therefore, about to send his boiler to France. When their great mail ships charge 20*l.* freight to India, letting us charge 30*l.*, he regards the new fuel as worthy of being considered. Water fuel, he says, appears to be the handle by which complete combustion, with the total absence of smoke, is obtained from liquid coal.

ALBERTITE.—The exploration of the Albertite mineral, carried on by Mr. John Martin on the Duchess of Sutherland's property at Strathpeffer, continues to be highly satisfactory. For the last two months Mr. Martin has, with the Duke's consent, been engaged sinking bores and making trial holes to ascertain the quantity and quality of this jet-like substance, which is found on the hill behind Castle Leod. In a bore 53½ ft. deep the men have struck a seam 25 in. thick of beautiful Albertite, proving, as stated by Prof. Penny, that the mineral increases in quantity and quality the further they descend. From analyses that have been made of this mineral, it is found to contain about 115 gallons of crude oil to a ton. This will be a great acquisition to the property of the Duchess, and the working of such coal in the North may prove an addition to the revenue of the Highland Railway, besides being the means of creating labour to the people of the district. The exploration has attracted the attention of several scientific gentlemen, and Mr. Martin has had various communications on the subject from professors and others interested in the discovery of such a valuable mineral in this country, and, perhaps, he may succeed in obtaining it in a fluid state if the men get deep enough.—*Inverness Courier*.

COLLECTING GASES FROM BLAST-FURNACES.



In collecting and drawing off the gases from blast-furnaces, the object should be to interfere as little as possible with the perfect dissemination of the gases at the throat of the furnace, to offer a considerably increased area for their escape, and so to diminish the velocity of the gases through the "draw-off," as well as to keep the top or throat of the furnace open, clear, and unobstructed for charging. These conditions have been embodied in a recent patent by Messrs. J. and G. ADDENBROOKE and Mr. P. A. MILLWARD, of Darlaston,—and which is described and illustrated in the *Mechanics' Magazine*. In order to more thoroughly disseminate the gases at the top of the furnace than by other modes in which they are generally concentrated, the inventors forms a number of openings round the throat, at about 4 or 5 ft. from the top. They also form an enclosed channel or gas flue, between which and the interior of the furnace itself these openings form separate and collective communications. At any convenient point at the side of the aperture, flue, or circular confluence chamber last mentioned, a main opening is made. Through this main opening the collected gases are conducted, first into a receiver and thence through suitable pipes or tubes to any places at which they are intended to be utilised. The apertures above mentioned through the neck of the furnace are made to incline downwards from the exterior to the interior surface at a considerable angle, in order to prevent any of the materials when charged falling or escaping from the interior of the furnace through the apertures into the confluence chamber or flue surrounding the same. The apertures are formed of cast-iron in segments, and placed level with each other in the neck of the furnace about 4 ft. 9 in. from the top. They may, however, be fixed at different levels, and be formed partly or entirely of fire-brick or other suitable material.

When formed as segments or frames of cast-iron and placed side by side the required aggregate area of gas-passage is obtainable with less depth of opening than by any other mode in use; the apertures being very shallow and all level with each other, they occupy less depth of furnace; in practice this is found to be of considerable importance. By this arrangement and construction not only a much larger area of opening is obtained for the free exit of the gases, but the less depth of furnace taken up enables the "draw-off" to be worked nearer to the surface of the charge or materials fed than by any other plan—at a depth of not more than 4 ft. 6 in. or 4 ft. 9 in. This shallowness of the gas openings also allows the more thorough preparation of the materials charged, as the gas continues amongst them to very nearly the full height of the furnace. For the introduction of these improvements narrow-throated furnaces do not require to be widened, as is the case when a cylinder, bell-dome, or brick arching is adopted; on the contrary, furnaces which are now too narrow will have their capacities increased by the addition of the apertures herein described, as the gases then pass off freely below the narrow part of the throat. This increase in the area of the draw-off also reduces the velocity of the gases, and, consequently, diminishes their tendency to carry dust into the flues and conduits. For cleaning out the confluence chamber small damper-closed apertures are formed through the outside casing of flue and furnace. For regulating the suction through the draw-off conduit pipes or tubes, or for closing the same when required, a balanced disc valve or damper is fitted therein.

In the annexed engraving, Fig. 1 represents a vertical section of a furnace constructed according to this invention; Fig. 2 is a plan at the line A, B, Fig. 1; Fig. 3 shows an inner face view of an iron segmental aperture frame; Fig. 4 is a section through the same at C, D; and Fig. 5 a sectional plan at E, F: *a* is the throat of the furnace; *b*, *b*, the sides; *c*, *c*, the charging doors; and *d* the furnace head. On reference to Fig. 1 it will be seen that the throat and head of the furnace are open throughout; *e*, *e*, are the draw-off apertures in the sides of the throat; *f*, the chamber or flue surrounding the apertures, and into which chamber the gases are drawn; *h*, the branch main connecting the chamber or flue with the receiver; *i*, the receiver; *j*, the suction main; *k*, the balanced disc, by which the connection between the receiver and suction main and conduit is opened, closed, and regulated, as required; *l*, *l*, small openings pierced in the outer wall of the aperture chamber for cleaning out the bottom of the flue when necessary.

The mode of working the furnace is as follows:—The materials are charged at top in the usual way, and the blast applied at the tuyeres. The highly heated gaseous products of combustion then rise from the zone of fusion, and in their upward course roast off various volatile gases from the descending materials; with these they mingle, and together they are usually allowed to escape to waste freely at the tunnel head. Openings are placed for the escape of the gases some 4 ft. below the filling level, or usual point of their escape. The 4 ft. of materials charged above the openings acts to a certain extent as a damper, and as there is a slight suction or draught into the openings, caused by the pull of chimney, the gases are induced to pass into and through the apertures in preference to forcing their way upwards through the materials charged. The inclined surfaces of the apertures prevent the materials charged from passing out of the furnace into the induction chamber. The damper, *k*, as it is opened or closed more or less regulates the power of the suction. The side apertures materially increase the area for the escape of the gases, and greatly relieve a narrow-throated furnace, inasmuch as they are drawn out of the furnace before reaching the narrowest point.

UTILISATION OF FIRE-DAMP.—There can be little doubt that both coal owners and colliers will appreciate in a high degree an invention which not only removes the inconvenience attending the presence of fire-damp in collieries, but actually turns it to profitable account in the working of the mine, and an invention of this character is now proposed to be introduced. Mr. JAMES PARKER, of Lilford-road, Camberwell, states that he is enabled to use atmospheric air and steam in combination as a motive power in any ordinary low pressure condensing steam-engine without any increase in the size of the cylinder. The improvements consist in using a condenser, having a partial vacuum into which is discharged the exhaust steam and air, or moist air from the cylinder, by which means the steam or moisture in the air, or a large part of it, condenses, and the air previously in combination with the steam cools and contracts considerably, and it is then drawn off from the condenser by steam jets and nozzles, similar to those used to drive in the atmospheric air. The aerated condensed water deposited in the condenser may be economically employed in steam-vessels to feed the boiler, or be available for the use of the ship's company, instead of the ordinary distilled sea water. The vacuum pressure for motive power obtained by the means mentioned is much more economically obtained than by the means of machinery similar and analogous to that employed in the pneumatic railway for the purpose, and compressed air of low pressure (the temperature of which can be regulated at pleasure by being brought more or less into contact with cold water) can also be more economically supplied by the same arrangment of jets and nozzles, than by the machinery now used for the purpose. The vacuum pressure may be applied where it desirable to use a cold motive power, or one not liable to loss by condensation. The boiler and jets and nozzles may be placed at a distance of even several miles from the vacuum engine with but very little loss of power, and, therefore, will be of great service for mining purposes, and also because the foul air or gas in the mine will thereby be drawn from the mine and be replaced by a constant stream of fresh atmospheric air flowing into the mine to restore the equilibrium of pressure. The foul air or gas drawn from the mine, if inflammable, will be discharged into the fire of the boiler outside the mine, where it will be used as fuel to generate steam. Mr. Parker thinks that in some cases the discharged gas will supply the greater part of the heat necessary for working all the engines, underground and at surface, of the mine.

SALES OF COPPER ORES.

COPPER ORES SOLD AT THE CORNWALL TICKETINGS FOR THE QUARTER ENDING SEPTEMBER, 1866:—

Mines.	Tons.	Amount.		
Devon Great Consols	5444	£23,801	2	0
Clifford Amalgamated	3533	12,279	8	0
South Caradon	1325	10,388	18	0
West Seton	1506	6,792	17	0
Marke Valley	1320	4,341	0	0
Hingston Down	1200	3,995	18	0
Wheal Seton	1155	3,577	17	0
East Caradon	951	3,374	3	0
Wheal Rose	753	3,264	19	0
North Treskerby	671	3,208	14	0
Prosper United	1006	3,015	14	6
Wheal Friendship	544	2,994	7	0
Wheal Basset	543	2,795	18	0
West Basset	503	2,781	0	6
East Carn Brea	615	2,196	14	6
Fowey Consols	509	1,964	2	0
Phœnix	705	1,889	18	6
Devon and Cornwall	564	1,798	19	6
East Rosewarne	307	1,704	14	6
Wheal Emma	297	1,627	5	6
West Caradon	317	1,593	9	0
Great Wheal Busy	705	1,493	9	0
East Pool	494	1,382	9	6
Bedford United	339	1,380	2	6
South Frances	267	1,341	1	6
Botallack	188	1,240	10	0
Bampfylde	104	1,221	1	0
Brookwood	255	1,157	18	6
South Crofty	294	1,076	4	0
Craddock Moor	227	1,032	14	0
West Tolgus	311	967	15	6
East Wheal Russell	285	961	2	0
Wheal Margery	324	898	9	0
Carn Camborne	291	888	6	6
Tolcarne	264	876	4	6
Carn Brea	281	871	17	6
Rosewarne United	145	859	19	6
New Wheal Martha	559	852	15	0
Gawton	248	835	19	0
West Damsel	228	832	10	0
North Roskear	202	824	15	6
South Tolgus	182	741	8	6
Okel Tor	320	715	9	6
Crenver and Abraham	188	705	3	0
Dolcoath	113	553	8	6
Copper Hill	187	538	10	0
Par Consols	138	519	5	0
Gunnislake	154	469	15	0
Great South Tolgus	135	430	3	6
Camborne Vean	135	425	7	0
Glasgow Caradon	169	419	0	0
Hallenbeagle	120	412	0	0
Wheal Crebor	131	394	8	6
Great North Downs	100	384	17	6
Levant	70	374	18	6
East Basset	128	383	4	0
South Condurrow	93	352	1	0
East Grenville	131	336	4	0
Fursdon	53	318	16	6
New Cornish	70	292	5	0
Nangiles	117	254	3	6
Rosewarne Consols	52	226	8	6
Wheal Polmear	40	216	0	0
Pendeen Consols	43	215	1	0
Tincroft	88	215	0	0
Grambler and St. Aubyn	28	214	4	0
Wheal Buller	46	213	3	6
Molland	40	202	0	0
North Grambler	42	200	8	0
Mellanear	67	188	10	6
North Downs	41	164	0	0
South Dolcoath	36	162	18	0
St. Day United	50	150	10	0
North Basset	58	145	8	0
Great Brigan	32	138	8	0
Wheal Curtis	49	136	17	6
Gonamena	70	124	11	6
West Beam	10	123	10	0
Sortridge Consols	25	110	12	6
Pendarves United	37	107	9	0
South Carn Brea	20	85	10	6
Tresavean	30	82	2	6
Lady Bertha	54	72	18	0
West Condurrow	17	71	16	6
Wheal Grenville	17	69	5	6
West Stray Park	16	66	0	0
Wheal Union	14	63	14	0
Crane	12	53	2	0
Wheal Agar	11	52	16	6
Wheal Edward	17	49	14	6
Bugelhole's Ore	14	47	6	0
Hawkmoor	16	40	8	0
Collacombe	10	29	5	0
Wheal Uny	4	24	14	0
Tolvadden	6	15	12	0
South Wheal Alfred	3	7	8	6
Wheal Harriett	2	0	12	0
New Rosewarne	4	0	11	6

COMPANIES BY WHOM THE ORES WERE PURCHASED.

Vivian and Sons	5477	£23,715	5	11
Freeman and Co.	1769	9,702	13	4
P. Grenfell and Sons	2568	14,421	19	1
Sims, Willyams, and Co.	3770	13,207	10	0
Williams, Foster, and Co.	5103	22,474	3	6
Mason and Elkington	2543	8,459	10	2
Bankart and Son	3361	11,259	18	1
Copper Miners' Company	2699	8,507	15	8
Charles Lambert	2196	6,174	2	8
Newton, Keates, and Co.	652	2,428	2	0
Sweetland, Tuttle, and Co.	1882	7,288	8	7
Penclawdd Copper Company	596	2,721	14	6
Hadland and Co.	425	1,334	13	6
Goole Alum and Smelting Company	524	1,946	3	0
Total	33,761	£133,642	0	0

SALES OF COPPER ORES.

COPPER ORES SOLD AT THE SWANSEA TICKETINGS FOR THE QUARTER ENDING SEPTEMBER, 1866:—

Mines. BRITISH.	Tons.	Amount		
Berehaven	866	£ 5,684	11	6
Ballycummisk	142	1,024	4	0
Connorree	100	366	1	0
Great Laxey	96	319	4	0
Total	1204	£ 7,394	0	6
COLONIAL.				
Moonta	548	£ 9,060	5	0
Newfoundland	660	5,451	10	6
New Cornwall	337	3,214	15	0
Wallaroo	524	3,177	4	6
Cape	110	2,160	1	0
Concordia	145	1,955	10	0
African	56	774	10	6
Kurilla	13	139	8	6
Australian	2	16	3	0
Total	2395	£25,949	8	0
FOREIGN.				
Cuba	1237	£15,305	7	0
Cobre	1218	10,971	14	6
Californian	729	6,969	15	0
Seville	151	1,179	18	6
Leghorn	92	735	19	0
Peruvian	24	585	0	0
Casali	30	266	5	0
Spanish	48	158	8	0
Genoa	19	148	18	6
Lisbon	17	113	6	0
Victor Emanuel	13	92	12	6
Total	3578	£36,527	4	0
RECAPITULATION.				
British	1204	7,394	0	9
Colonial	2395	25,949	8	0
Foreign	3578	36,527	4	0
Slag, Calcined, and sundries	8689	8,469	7	6
Total	8866	£78,340	0	0

COMPANIES BY WHOM THE ORES WERE PURCHASED.

Copper Miners' Company	612	4,709	8	6
Freeman and Co.	543	5,070	6	0
Grenfell and Sons	800	7,958	6	6
Sims, Willyams, and Co.	509	6,184	6	9
Vivian and Sons	1268	11,645	16	0
Williams, Foster, and Co.	1290	11,000	18	0
British and Foreign Copper Co.	248	2,111	4	9
Mason and Elkington	319	2,517	14	6
Bankart and Sons	217	1,967	16	0
Charles Lambert	999	7,342	3	0
Ravenhead Copper Co.	538	6,301	8	9
Sweetland, Tuttle, and Co.	370	4,322	0	6
Hadland and Co.	176	1,251	16	0
Penclawdd Copper Company	979	5,956	14	9
Total	8866	£78,340	0	0

MANUFACTURE OF ZINC.—The invention of Mr. C. W. SIEMENS consists in so arranging the zinc pots, retorts, or tubes, that they can be continuously or otherwise charged with the materials for the production of zinc, and after the volatile metal has been distilled therefrom, and that the residue can be removed continuously or otherwise without in any way arresting the ordinary working of the furnaces, thus effecting a very considerable economy in time and fuel.

NITRO-GLYCERINE.—I have been intending for some time to send you some remarks respecting the use and manufacture of nitro-glycerine. The explosions that occurred at San Francisco and Aspinwall should have given full warning to every person not to trifle with this greatest of all explosive substances, but those accidents have not had that desired effect, as has already been demonstrated in the laboratories of several very clever chemists, who have recently attempted experiments in its composition on a small scale. The public should be cautioned in its use, as none but the very best materials, in exact proportions, and skilfully prepared, will make an article which is not liable to accidental explosion. From my knowledge of Mr. Nobel, the Swedish inventor, and my recent acquaintance with the members of the United States Blasting Oil Company, who are erecting works on a large scale for its manufacture in New York, I feel safe in saying the public may rely on obtaining from them an article which can be more safely handled and transported than gunpowder. The violation of the patents upon the subject is of small importance, but the endangering of life, by an imperfection of its manufacture, is serious. I have had, probably, more experience in the use of nitro-glycerine than any other man living—extending back many years—and I intend to prepare for you some instructions to miners how to use it, to the end that accidents may be prevented. I have never had any misfortune to life or person, and there need not be any by its use for blasting purposes. Proper precautions should be taken, but these precautions are not so many as those required to be observed in the use of gunpowder. Recently, at the Hoosac Tunnel, I removed within three days, and with 28 blasts, 60 7·10 feet lineal, 14 feet wide, and 5 feet deep, far excelling any blasting ever before executed. Electricity was used to produce simultaneous explosion. The above, however, can be increased by another experiment to at least 80 feet. What other substance can effect such a wonderful achievement? The expense was less than the cost of the powder that would have been required to do the same execution. Nitro-glycerine can be poured directly into the drill-hole, but I prefer to use a tin cartridge, with wooden stopper, firmly fixed with fuse orifice. The cartridge should not be full, nor should any vessel in which it is placed. Some little space should always be allowed. In cans, a small quantity of water, one half-pint per gallon, should be kept upon the surface of the nitro-glycerine. When in store the cans need not be stoppered, but the temperature should not exceed 70°, though it is not possible to explode it under 360°. The floor of the magazine should be plaster of Paris, or earth, never wood. Never use a vessel that has contained nitro-glycerine for any other purpose, and before using it for that place water in it for a few hours, always cleaning the vessel before using it for that purpose. Nitro-glycerine is poisonous, and care should be taken not to allow it to touch the flesh, as it produces, with some people, a very severe headache. It should not be taken in the mouth. Forty drops have killed a dog, but a reckless man took much more without injury. It does not effect some people, while others suffer intensely with headache. These are simple precautions, and their observance will prevent accidents. The manner of using it for blasting purposes, and the arrangements necessary to observe for the disruption of the greatest quantity of rock, I will reserve for another letter.—TAL. P. SHAFFNER: *Scientific American*.

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